

AMENDMENTS TO THE CLAIMS

Claim 1 (original): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, said circuit writing data from said plurality of processing elements to said memory in a horizontal mode and reading data stored in said main memory in a horizontal mode from said main memory to said plurality of processing elements.

Claim 2 (original): The active memory device according to claim 1, wherein said circuit is further adapted to write data from said plurality of processing elements to said memory in a vertical mode and read data stored in said main memory in a vertical mode from said main memory to said plurality of processing elements.

Claim 3 (original): The active memory device according to claim 1, wherein a plurality of processing elements in a first group are coupled to a plurality of data buses of said main memory, each of said plurality of data buses being associated with a respective one of a plurality of addresses in said main memory.

Claim 4 (original): The active memory device according to claim 3, wherein said first group includes eight processing elements.

Claim 5 (original): The active memory device according to claim 1, wherein said circuit further comprises:

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of said plurality of processing elements and said main memory.

Claim 6 (original): The active memory device according to claim 5, wherein each of said plurality of circuits further comprises:

a plurality of logic circuits, each of said plurality of logic circuits having a first input and an output, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory; and

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of said plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements.

Claim 7 (previously presented): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, said circuit writing data from said plurality of processing elements to said main memory in a horizontal mode and reading data stored in said main memory in a horizontal mode from said main memory to said plurality of processing elements, said circuit comprising

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of said plurality of processing elements and said main memory, each of said plurality of circuits comprising:

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements; and wherein each of said plurality of logic circuits comprises:

a first input, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory;

an output;

a second multiplexer having a first input coupled to said associated respective one of said plurality of processing elements and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output coupled to said output of said logic circuit;

a first tri-state device having an input coupled to said output of said first register and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said first register and an output coupled to one of said plurality of data buses and a third input of said second multiplexer.

Claim 8 (original): The active memory device according to claim 7, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 9 (previously presented): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, said circuit writing data from said plurality of processing elements to said main memory in a horizontal mode and reading data stored in said main memory in a horizontal mode from said main memory to said plurality of processing elements, said circuit comprising

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of said plurality of processing elements and said main memory, each of said plurality of circuits comprising:

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements; and wherein each of said plurality of logic circuits each comprises:

a first input, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory;

an output;

a second multiplexer having a first input coupled to said associated respective one of said plurality of processing elements and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output;

a second register having an input coupled to said output of said second multiplexer and an output;

a third multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output coupled to said output of said logic circuit;

a fourth multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output;

a first tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to one of said plurality of data buses and a third input of said second multiplexer.

Claim 10 (original): The active memory device according to claim 9, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 11 (previously presented): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits having a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory, and an output coupled to said single bit input of a respective one of said plurality of processing elements,

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time.

Claim 12 (previously presented): The active memory device according to claim 11, wherein each of said data path circuits is further adapted to write data from said plurality of processing elements to said main memory in a vertical mode and read data stored in said main memory in a vertical mode from said main memory to said plurality of processing elements.

Claim 13 (previously presented): The active memory device according to claim 11, wherein each of said plurality of data path circuits further comprises:

a plurality of logic circuits, each of said plurality of logic circuits having a first input and an output, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit; and

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of said plurality of logic circuits, and an output coupled to said output of said data path circuit.

Claim 14 (previously presented): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits comprising:

a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory, and an output coupled to said single bit input of a respective one of said plurality of processing elements,

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to said output of said data path circuit; and wherein each of said plurality of logic circuits comprises:

a first input, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit;

an output;

a second multiplexer having a first input coupled to said first input of said data path circuit and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output coupled to said output of said logic circuit;

a first tri-state device having an input coupled to said output of said first register and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said first register and an output coupled to one of said plurality of data buses and a third input of said second multiplexer; and

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time.

Claim 15 (original): The memory device according to claim 14, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 16 (previously presented): An active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits comprising:

- a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory, and an output coupled to said single bit input of a respective one of said plurality of processing elements;

- a first multiplexer having a plurality of first multiplexer inputs, each of said plurality of first multiplexer inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to said output of said data path circuit; and wherein each of said plurality of logic circuits comprises:

- a first input, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit;

- an output;

- a second multiplexer having a first input coupled to said first input of said data path circuit and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output;

a second register having an input coupled to said output of said second multiplexer and an output;

a third multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output coupled to said output of said logic circuit;

a fourth multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output;

a first tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to one of said plurality of data buses and a third input of said second multiplexer; and

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time.

Claim 17 (original): The active memory device according to claim 16, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 18 (canceled)

Claim 19 (original): The circuit according to claim 20, wherein said output of said second tri-state device is coupled to a different data bus than said output of said first tri-state device.

Claim 20 (original): A circuit for connecting a memory device and a processing element of an active memory comprising:

a first multiplexer having a first input coupled to said processing element and a second input coupled to a data bus of said memory device;

a first register having an input and an output, said input being coupled to an output of said first multiplexer;

a second multiplexer having an input coupled to said output of said first register and an output coupled to said processing element;

a first tri-state device having an input coupled to said output of said first register and an output coupled to said data bus;

a second tri-state device having an input coupled to said output of said first register and an output coupled to said data bus and a third input of said first multiplexer;

a second register having an input coupled to said output of said first multiplexer;

a third multiplexer having a first input, a second input, and an output, said first input being connected to an output of said second register, said output from said first register being coupled to said second input, said output being coupled to said input of said second multiplexer; and

a fourth multiplexer having a first input, a second input, and an output, said first input being coupled to said output of said first register, said second input being coupled to said output of said second register, said output being coupled to said input of said first and second tri-state devices.

Claim 21 (original): The circuit according to claim 20, wherein said output of said second tri-state device is coupled to a different data bus than said output of said first tri-state device.

Claim 22 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, wherein said circuit is adapted for:

writing data from said plurality of processing elements to said memory in a horizontal mode and reading data stored in said main memory in a horizontal mode from said main memory to said plurality of processing elements, and

writing data from said plurality of processing elements to said memory in a vertical mode and read data stored in said main memory in a vertical mode from said main memory to said plurality of processing elements.

Claim 23 (cancel):

Claim 24 (original): The processing system according to claim 22, wherein a plurality of processing elements in a first group are coupled to a plurality of data buses of said

main memory, each of said plurality of data buses being associated with a respective one of a plurality of addresses in said main memory.

Claim 25 (original): The processing system according to claim 24, wherein said first group includes eight processing elements.

Claim 26 (original): The processing system according to claim 22, wherein said circuit further comprises:

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of said plurality of processing elements and said main memory.

Claim 27 (original): The processing system according to claim 26, wherein each of said plurality of circuits further comprises:

a plurality of logic circuits, each of said plurality of logic circuits having a first input and an output, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory; and

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of said plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements.

Claim 28 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, said circuit writing data from said plurality of processing elements to said main memory in a horizontal mode and reading data stored in said main memory in a horizontal mode from said main memory to said plurality of processing elements, said circuit comprising:

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of

said plurality of processing elements and said main memory, and each of said plurality of circuits comprising:

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements; and wherein each of said plurality of logic circuits comprises:

a first input, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory;

an output;

a second multiplexer having a first input coupled to said associated respective one of said plurality of processing elements and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output coupled to said output of said logic circuit;

a first tri-state device having an input coupled to said output of said first register and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said first register and an output coupled to one of said plurality of data buses and a third input of said second multiplexer.

Claim 29 (original): The processing system according to claim 28, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 30 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being coupled to a respective portion of said main memory by a single bit connection; and

a circuit coupled between said main memory and said plurality of processing elements, said circuit writing data from said plurality of processing elements to said memory in a horizontal mode and reading data stored in said main memory

in a horizontal mode from said main memory to said plurality of processing elements, said circuit comprising:

a plurality of circuits, each of said plurality of circuits being associated with a respective one of said plurality of processing elements, each of said plurality of circuits passing data between its associated respective one of said plurality of processing elements and said main memory, and each of said plurality of circuits comprising:

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of said plurality of logic circuits, and an output coupled to its associated respective one of said plurality of processing elements; and wherein each of said plurality of logic circuit comprises:

a first input, said first input being coupled to a respective one of a plurality of data buses, each of said plurality of data buses being coupled to said main memory;

an output;

a second multiplexer having a first input coupled to said associated respective one of said plurality of processing elements and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output;

a second register having an input coupled to said output of said second multiplexer and an output;

a third multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output coupled to said output of said logic circuit;

a fourth multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output;

a first tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to one of said plurality of data buses and a third input of said second multiplexer.

Claim 31 (original): The processing system according to claim 30, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 32 (original): The processing system according to claim 22, wherein said processing unit and said active memory device are on a same chip.

Claim 33 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits having a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory, and an output coupled to said single bit input of a respective one of said plurality of processing elements,

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time; and

wherein each of said data path circuits is further adapted to write data from said plurality of processing elements to said main memory in a vertical mode and read data stored in said main memory in a vertical mode from said main memory to said plurality of processing elements.

Claim 34 (cancel):

Claim 35 (original): The processing system according to claim 33, wherein each of said plurality of data path circuits further comprises:

a plurality of logic circuits, each of said plurality of logic circuits having a first input and an output, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit; and

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of said plurality of logic circuits, and an output coupled to said output of said data path circuit.

Claim 36 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits comprising:

a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory;

an output coupled to said single bit input of a respective one of said plurality of processing elements;

a first multiplexer having a plurality of inputs, each of said plurality of inputs being coupled to an output of a respective one of a plurality of

logic circuits, and an output coupled to said output of said data path circuit; and wherein each of said plurality of logic circuits comprises:

a first input, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit;

an output;

a second multiplexer having a first input coupled to said first input of said data path circuit and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output coupled to said output of said logic circuit;

a first tri-state device having an input coupled to said output of said first register and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said first register and an output coupled to one of said plurality of data buses and a third input of said second multiplexer; and

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time.

Claim 37 (previously presented): The processing system according to claim 36, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 38 (previously presented): A processing system comprising:

a processing unit; and

an active memory device coupled to said processing unit, said active memory device comprising:

a main memory;

a plurality of processing elements, each of said plurality of processing elements being associated with a respective portion of said main memory, each of said plurality of processing elements having a single bit data output and a single bit data input; and

a plurality of data path circuits, each of said plurality of data circuits being coupled between said main memory and one of said plurality of processing elements, each of said plurality of data path circuits comprising:

a plurality of inputs, a first input of said plurality of inputs being coupled to said single bit output of a respective one of said plurality of processing

elements, at least a second input of said plurality of inputs being coupled to a respective one of a plurality of data buses of said main memory;

an output coupled to said single bit input of a respective one of said plurality of processing elements;

a first multiplexer having a plurality of first multiplexer inputs, each of said plurality of first multiplexer inputs being coupled to an output of a respective one of a plurality of logic circuits, and an output coupled to said output of said data path circuit; and wherein each of said logic circuit comprises:

a first input, said first input being coupled to said at least a second input of said plurality of inputs of said data path circuit;

an output;

a second multiplexer having a first input coupled to said first input of said data path circuit and a second input coupled to said input of said logic circuit;

a first register having an input coupled to an output of said second multiplexer and an output;

a second register having an input coupled to said output of said second multiplexer and an output;

a third multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said

second register, and an output coupled to said output of said logic circuit;

a fourth multiplexer having a first input coupled to said output of said first register, a second input coupled to said output of said second register, and an output;

a first tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to said respective one of said plurality of data buses; and

a second tri-state device having an input coupled to said output of said fourth multiplexer and an output coupled to one of said plurality of data buses and a third input of said second multiplexer;

wherein each of said data path circuits is adapted to receive data from said respective one of said plurality of processing elements a single bit at a time and write said data to said main memory in a horizontal mode, and to receive data stored in said main memory in a horizontal mode and output said data to said respective one of said plurality of processing elements a single bit at a time.

Claim 39 (original): The processing system according to claim 38, wherein said output of said second tri-state device is coupled to said respective one of said plurality of data buses.

Claim 40 (original): The processing system according to claim 33, wherein said processing unit and said memory device are on a same chip.

Claim 41 (previously presented): A method for writing data from a processing element to a memory device comprising the steps of:

providing a plurality of data bits in a serial manner from said processing element to a data circuit;

passing said data through said data circuit; and

writing said data to said memory device,

wherein said data circuit passes said data directly to said memory device in a horizontal mode and

wherein said step of passing said data further comprises:

outputting each bit of said plurality of data bits from said data circuit on a different data bus associated with said memory device;

wherein said step of writing said data further comprises writing said each bit of said plurality of data bits to a location in said memory device associated with a different address; and

wherein said circuit is further adapted to pass at least a portion of said data to said memory device in a vertical mode.

Claim 42 (canceled)

Claim 43 (previously presented) The method according to claim 41, wherein said step of outputting further comprises:

passing each bit of said plurality of data bits through a respective register.

Claim 44 (previously presented): The method according to claim 41, wherein each different memory address has an associated plurality of bits, and wherein said step of writing each said data bit further comprises:

writing said each bit into a same bit of said associated plurality of bits in each said different memory address.

Claim 45-47 (cancel):

Claim 48 (previously presented): A method for reading data stored in a memory device and providing said data to a processing element, said method comprising the steps of:

providing a plurality of data bits from said memory device to a data circuit;

passing said data through said data circuit; and

outputting said data to said processing element in a serial manner, and

wherein at least a portion of said data is stored in said memory device in a vertical mode.

Claim 49 (original): The method according to claim 48, wherein said step of passing said data further comprises:

passing each bit of data associated with a single address through a respective register; and

inputting said each bit of data associated with said single address to a multiplexer,

wherein said multiplexer outputs said each bit of data in a serial manner to said processing element.

Claim 50 (canceled)

Claim 51 (previously presented): The method according to claim 48, wherein said step of passing said at least a portion of said data further comprises:

passing a respective bit of data associated with a different address through a respective register; and

inputting each said respective bit of data associated with said different address to a multiplexer,

wherein said multiplexer outputs said each said respective bit of data in a serial manner to said processing element.